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by the retraction of the animal as a whole. It thus appears that the connections between the surface of the sea-anemone and the deep seated muscles concerned with retraction are so numerous and devious that a nervous network is the only basis of explanation. That this nervous network is not equally developed in all parts of the animal's body is seen from the fact that when a sea-anemone is cut vertically in two except for the lips, it is very difficult to get a retraction in one half of the body when the stimulus is applied to the other half. The lips are poor means of transmission compared with other parts of the body. Notwithstanding the generally diffuse condition of the transmission system in *Metridium*, there is evidence also for a certain degree of specialization in the parts concerned. Stimulation of the tentacles by mussel juice calls forth a gaping of the oesophagus (contraction of the transverse mesenteric muscles) and by weak hydrochloric acid a retraction of the oral disc (contraction of the longitudinal mesenteric muscles). These two forms of response afford good ground not only for the assumption of independent receptors but of relatively independent transmission tracts, a first step in the kind of differentiation so characteristic of the nervous organization in the higher animals.

The extended paper will be published in the *Journal of Experimental Zoölogy*.

THE RESPONSES OF THE TENTACLES OF SEA-ANEMONES

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As long ago as 1879 von Heider announced that tentacles severed from a sea-anemone were capable of much the same range of activities that these organs exhibit when normally attached to the animal. This statement has been variously accepted or questioned by subsequent workers. Favorable material for testing its validity was found in the Bermudian sea-anemone *Condylactis*. The tentacles of this form may measure as much as 15 cm. in length and may have a basal diameter of 1.5 cm. Severed tentacles from *Condylactis* contract and remain so for some time. They can be brought to a state of least disturbance by suspending them on a metal hook in seawater. Under such circumstances they can be inflated by gently running seawater into them till they attain about two-thirds their ordinary length. In this condition they are under a pressure of not over a few millimeters of water. If this

internal pressure is much increased, they will contract vigorously and discharge more or less of their contents. The slightly contracted state of the excised tentacle is therefore not due to lack of pressure. It is also not due to the absence of inhibitory influences from the rest of the animal, for, if an attached tentacle is partly cut into at its base, it exhibits the same partial contraction that the excised tentacle does. It is highly probable that the incomplete expansion of severed tentacles is due to the operative complications which are involved in cutting it and which induces a heightened tonicity in its musculature.

When an excised suspended tentacle is stimulated mechanically or by the application of weak acetic acid, mussel juice, or a weak solution of quinine, appropriate responses are called forth that differ from those of the attached tentacles only in that they are feebler and less precise. As this modified form of response is also noticeable in attached tentacles which by previous stimulation have been partly contracted before the particular stimulus was applied, it is believed that the feebleness and lack of precision in the reactions of the excised tentacles is due to their partly contracted condition and not, for instance, to the loss of central influences. Since the excised tentacles exhibit a range of responses like those of the normal ones except in so far as operative conditions modify them, it seems clear that the tentacles of sea-anemones must contain within themselves the neuromuscular mechanism essential to their activities as originally suggested by von Heider.

When various stimuli are applied to the ectoderm of an excised tentacle, they are followed quickly by a muscular response. When they are applied to the entoderm of a tentacle by being injected into its interior, they are also followed by the same form of response but only very slowly. This slowness in reaction is believed to be due to the non-receptive character of the entodermal surface and to the necessity for the stimulating material to the wall of the tentacle before it can reach the receptive ectoderm on the outside. Such a transfusion has been demonstrated in the case of weak acetic acid.

The tentacles of *Condylactis* like those of other sea-anemones, exhibit polarity. Their cilia beat always from the base of the tentacle towards its tip. If the tentacle is stimulated mechanically at a particular spot, the resultant muscular activity spreads from the stimulated spot almost exclusively toward the base of the tentacle. The ciliary polarity is unaffected by anesthetics, but that of the muscles largely disappears under such treatment. The muscular polarity seems, therefore, to depend upon a nervous condition and is probably due to the fact that the majority of nerve-fibers from the ectodermal sense-cells extend

toward the base of the tentacle, not toward its tip, and thus deliver impulses proximally rather than distally along the tentacle.

From these various observations, it is concluded that the tentacles of sea-anemones, in contradistinction to such appendages as those of the arthropods and of the vertebrates, must be regarded as containing within themselves a complete neuromuscular mechanism by which their responses can be carried out quite independently of the rest of the animal. These organs thus possess great autonomy and act in harmony and unison more because of simultaneous stimulation than of subordination to a common nervous centre.

The full paper will be published in the *Journal of Experimental Zoölogy*.